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attendance in the capitol building if his presence were desired for the consideration of any matter affecting himself or the university. He was personally assured that nothing of any importance would come up. After the adjournment of the board, certain of its members told him that no action had been taken, and they made similar statements to reporters, who published their declaration in the newspapers.

All of this leads to the inquiry as to what really happened between June 6, 1911, and October last, when certain very important questions which were up for discussion and settlement during that interval must have seriously changed the relations of the president and members of the board. Since the published statement under consideration does not touch upon these subjects, considerations of official reserve preclude more than this allusion to them at this time.

If I may permit myself now to speak in the first person let me conclude by saying that no one can regret more than myself the necessity of discussing educational matters in this way. Since the board has denied to me the usual academic privilege of meeting them face to face for frank discussion and has chosen to say nothing to me except through newspaper reports I am compelled to follow their example. Only the consideration that the people of the state of Montana need to be informed for the protection of higher education, and of their state university in particular, leads me to address the same public before whom the university committee's report has been placed. I hope that the publicity given to these issues may result in nothing but good for higher education in Montana.—C. A. DUNIWAY, in *The Missoulian*.

SCIENTIFIC BOOKS

The Life of the Crustacea. By W. T. CALMAN, Sc.D. New York, The Macmillan Co. 1911. Pp. xiv + 290, with 32 plates and 85 figures in the text.

While the Crustacea have attracted many generations of able students, and while they possess a truly ponderous and rapidly growing

scientific literature, few attempts have been made at a popular exposition. All the more welcome is the work under review, in which the author, a well-known student and writer in this particular field, presents a sketch of the entire class, as a whole. His expressed purpose is to describe in particular the habits and modes of life, as well as "provide for readers unfamiliar with the technicalities of zoology an account of the more important scientific problems suggested by a study of the living animals in relation to their environment."

Excepting alone the insects, the Crustacea are perhaps the most diversified and the most interesting single class of invertebrates. In their multitudinous forms, whether in the seas, the fresh waters, or upon land, they offer a peculiarly attractive field for the study of nearly every problem raised by modern biology, including development, variation, sex, heredity, parasitism and other phases of evolution. The field is both difficult and alluring. We think that Dr. Calman has succeeded admirably in bringing together a host of significant facts bearing upon his subject, and in presenting them in a logical and interesting manner.

A chapter is devoted to the European lobster, considered as an exponent of the class, and following this are sections on Classification and Metamorphosis. Successive chapters (V.-X.) treat of Crustacea of the Seashore, the Deep Sea, Floating Crustacea of the Ocean, Crustacea of Fresh Waters, the Land, as Parasites and Messmates, all loaded with interesting facts and suggestions. A section devoted to "Crustacea in Relation to Man" is less satisfactory. The volume concludes with a review of Fossil Crustacea. The illustrations are both ample and good.

The author speaks from a wide and accurate knowledge of his subject, and such errors as we have noticed are of a minor character. In the superabundance of available materials, every student of this group is bound to find many omissions of matters more or less interesting or important. In the chapter on the lobster a number of statements need to be

revised in order to accord with our present knowledge of this form. We will note the following: The "liver" is now known to be both a digestive and absorbent organ, the finer particles of food being delivered to it directly from the pyloric end of the stomach-sac. The idea that when a "limb is cast off," the opening at the breaking plane becomes closed by a clot of blood, and that further bleeding is thus stopped, had been proved by Emmel to be an error; the stoppage is effected by definite valves, without which the animal would doubtless bleed to death.

A third species of lobster (*Homarus capensis*) is attributed to the Cape of Good Hope. We were under the impression that this shadowy species had never recovered from the aspersions cast upon it by Professor Huxley. Regarding the relation of the young crayfish to its mother (p. 77) many new facts have been brought to light by the studies of Andrews for both *Astacus* and *Cambarus*.

In discussing the phosphorescence of deep-sea crustacea (p. 126) it is noticed that many luminous forms are blind, but that in such cases luminous secretions are emitted from the skin without the aid of specially differentiated organs, the photophores, the complete meaning of which is puzzling, not to say embarrassing, as in certain prawns which illuminate their gill-chambers. We are reminded of a similar trouble regarding the ubiquitous tegumental glands, which occur among other places in the labrum, swimmerets, statocysts, the intestine and the gills. It might be interesting to inquire whether there is any relation between these organs and such parts of the skin as are responsible for the secretions referred to above. In another place it stated that while many deep-sea species are some tint of red, their eggs are blue or green. If these forms were originally emigrants from shallow water, the colors of the eggs would appear to have remained stable notwithstanding the change in the color and habits of the adult, a condition which is paralleled in certain birds like the magpie, wherein the mottled coloring of the egg is evidently older than the habit of covering the nest.

The author suggests that the exceedingly long, attenuated, and often hirsute character of the appendages of deep-sea crustacea may be an adaptation to prevent the animal from sinking in the ooze; we should rather regard such conditions as aids to the animals for feeling their way in the darkness, in other words, as means for increasing their exploratory powers, and for rendering the chemical sense and that of touch more effective.

Regarding the question of metamorphosis among crustacea of the abyss Dr. Calman remarks: "It would seem that, some way or other, the conditions were unfavorable for a free-swimming larval life; but they can not be altogether prohibitive, for many deep-sea crustacea have small eggs, and presumably a metamorphosis." There is certainly no doubt that such species with small eggs undergo a metamorphosis, but it does not follow that the young ascend a mile or more to the surface in order to accomplish it. Such young may pertain exclusively to the hypoplankton and keep near the bottom, or to the mesoplankton in strata not far above it. It would be interesting to know to what extent larvæ like those of lobsters and crabs which keep for a time at least near the surface, and belong to the epiplankton, can adapt themselves to the changes in pressure involved in falling through measured distances in the water. Experiments to settle this point could be made without great difficulty.

The author thus speaks of the various animals which form the floating population of the Sargassum: "All of them are colored olive-green, like the weed among which they live." Now the Sargassum which we have repeatedly encountered in the Gulf Stream in going to or from the West Indies was always a beautiful golden brown tint, flecked with white, the light spots being due to bryozoa which commonly encrust the floats of this plant. Moreover, the entire population—fish (*Pterophryne*), shrimp and a nudibranch mollusk—wore the same colors, and usually in the same simple pattern, brown with oblitative white spots.

To conclude, in the chapter on the Relation of the Crustacea to Man we miss any adequate account of the valuable lobster fisheries of the old and new worlds, or of the laborious experiments which have been made to rear the young of this much-prized crustacean, and which in America have finally led to success.

FRANCIS H. HERRICK

WESTERN RESERVE UNIVERSITY

Qualitative Chemical Analysis. A Laboratory Guide. By W. W. SCOTT, A.M., chief chemist, Baldwin Locomotive works, formerly Professor of Chemistry, Morningside College, New York. D. Van Nostrand Co. 1910. \$1.50 net.

A Course in Qualitative Chemical Analysis. By CHARLES BASKERVILLE, Ph.D., F.C.S., Professor in the Department of Chemistry of the College of the City of New York, and L. J. CURTMAN, Ph.D., Instructor in the Department of Chemistry of the College of the City of New York. The Macmillan Co. \$1.40 net.

We have in these two books further additions to our already long list of works on qualitative analysis.

The first contains a discussion of the ionic hypothesis, the mass law and other physical chemical principles with their applications to qualitative analysis, followed by a systematic study of the detection and separation of bases and acids, methods of analyzing an unknown substance and tables containing special data. The best methods of separation have been selected and a very valuable addition made in the form of notes on each group. In these notes the reasons for the various reactions used and the precautions recommended are discussed, thus enabling the student to work intelligently and not, as is so often the case, merely mechanically. This book can be recommended as an excellent laboratory guide to qualitative analysis, especially if the principles discussed in the theoretical part are applied to the reactions studied.

In the second work special emphasis is placed on the quantitative discrimination of the substances detected by qualitative meth-

ods of analysis as a preparation for quantitative analysis. In selecting methods of analysis those have been preferably chosen which they think can be most readily used by the student; especially if they give rise to precipitation tests which will enable the student to approximate the amounts present. As in the other work, explanatory notes have been introduced.

An objection the reviewer would make to this book is the almost complete absence of any applications of the present theories of solution and the mass law to the reactions of qualitative analysis. Although the statement is made in the preface that these matters are usually presented in lectures in general chemistry and may be taken up in lectures on qualitative analysis, they do not apply these in this book; but retain the molecular reactions and the theory of the formation of complex compounds in place of the methods which are now so generally taught.

J. E. G.

SPECIAL ARTICLES

CHANGES IN CHEMICAL ENERGY DURING THE DEVELOPMENT OF *FUNDULUS HETEROCLITUS*

ALTHOUGH at present it is hardly possible to do more than give a brief report of progress, nevertheless, the results which have been obtained from the calorimetric study of the beginning and end stages in the development of *Fundulus heteroclitus* harmonize so completely with the results gotten by Tangl and Farkas in the case of the chick and silkworm, respectively, that a brief account of the work appears warrantable at this time.

Omitting many details of technique, the methods employed in this study were as follows: The eggs of *Fundulus*, immediately after artificial fertilization, and the larvæ immediately after hatching, were dried at 40° C. This portion of the work was carried on at the Marine Biological Laboratory at Woods Hole, to whose director, Professor Frank R. Lillie, I am indebted for the use of a room. The material, which had been previously carefully counted, was then preserved in the dry state in ordinary phials until used for the chemical